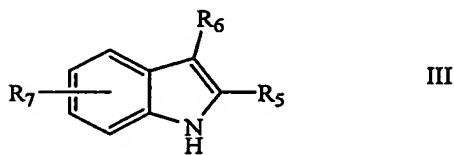
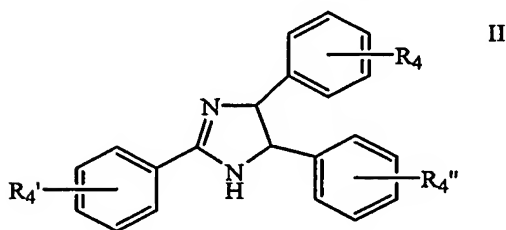
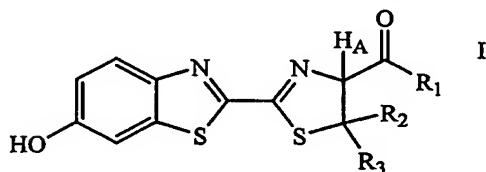
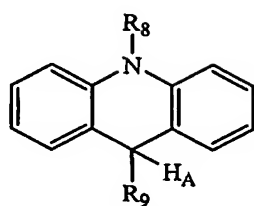


## CLAIMS

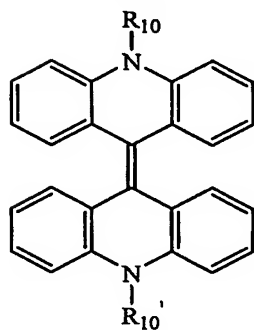
What is claimed is:

1. A projectile which illuminates a target on impact comprising:  
an autoxidative chemiluminescent agent;  
5 a solvent; and,  
a single chamber frangible shell surrounding the chemiluminescent agent and the solvent and capable of dispersing the chemiluminescent agent to react with atmospheric oxygen.
2. The projectile of claim 1 wherein the chemiluminescent agent is  
10 selected from the group consisting of benzothiazoles, 2,4,5-triarylimidazoles, indoles, N-substituted acridan nitriles and carboxylate esters, biacridines, 1,1'-bisisoquinolinium quaternary salts, products of 1,1'-bisisoquinolinium quaternary salts reaction with base, 2-aminopyridine Schiff bases, inidazo[1,2-a]pyridine-3(2H)-ones, and  
15 tetrakis(dialkylamino)ethylenes.
3. The projectile of claim 1 wherein the chemiluminescent agent is selected from the group consisting of compounds of Formulas I-IX, .

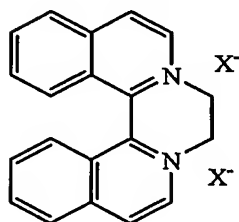




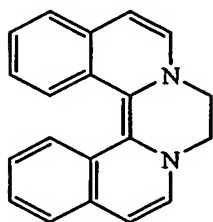
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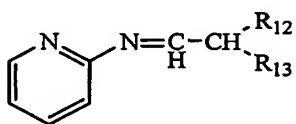
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VI

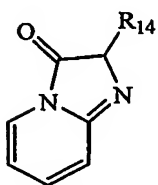


VII

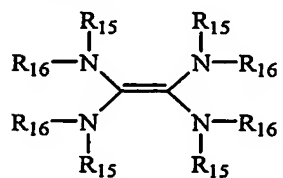


VIII

5



IX



X

in which the individual radicals have the following meanings:

R<sub>1</sub> may be a leaving group which in its protonated form has an acid constant (pK<sub>a</sub>) of  $1 \times 10^{-9}$  or greater but not aliphatic esters;

R<sub>2</sub> may be H, and C<sub>1</sub>-C<sub>12</sub> hydrocarbon including linear, branched, or cyclic hydrocarbon, aryl, benzyl, unsaturated hydrocarbon, alkoxyl, or  
5 halogen but halogen does not include iodine;

R<sub>3</sub> may be H, and C<sub>1</sub>-C<sub>12</sub> hydrocarbon including linear, branched, or cyclic hydrocarbon, aryl, benzyl, unsaturated hydrocarbon, alkoxyl, or halogen but halogen does not include iodine;

each R<sub>4</sub> may independently be H, C<sub>1</sub>-C<sub>12</sub> alkyl including linear,  
10 branched, or cyclic alkyl, C<sub>1</sub>-C<sub>12</sub> alkoxyl including linear, branched, or cyclic alkoxyl, cyano, C<sub>1</sub>-C<sub>12</sub> carboxy esters, C<sub>1</sub>-C<sub>12</sub> ketones, or halogen except that halogen does not include iodine, and R<sub>4</sub> cannot be nitro;

R<sub>5</sub> may be H, C<sub>1</sub>-C<sub>12</sub> alkyl including linear, branched, or cyclic alkyl or aryl;

15 R<sub>6</sub> may be H, C<sub>1</sub>-C<sub>12</sub> alkyl including linear, branched, or cyclic alkyl or aryl;

R<sub>7</sub> may be H, C<sub>1</sub>-C<sub>12</sub> alkyl including linear, branched, or cyclic alkyl, aryl, C<sub>1</sub>-C<sub>12</sub> alkoxy, or halogen but halogen may not be iodine, and R<sub>7</sub> cannot be nitro;

20 R<sub>8</sub> may be H, aryl, C<sub>1</sub>-C<sub>12</sub> alkyl including linear, branched, or cyclic alkyl;

R<sub>9</sub> may be cyano or ester of the formula -COZ wherein Z may be a leaving group which in its protonated form has an acid constant (pK<sub>a</sub>) of  $1 \times 10^{-9}$  or higher, preferably  $1 \times 10^{-6}$  or higher. Several such leaving groups  
25 are known in the art and by way of illustration may include phosphate, phenol, thiophenol, aryl esters, and various heterocycles, but R<sub>8</sub> may not be aliphatic esters;

each R<sub>10</sub> may independently be H, C<sub>1</sub>-C<sub>12</sub> alkyl including linear, branched, cyclic alkyl, or aryl;

30 R<sub>12</sub> may be H, C<sub>1</sub>-C<sub>12</sub> alkyl including linear, branched, cyclic alkyl, or aryl;

R<sub>13</sub> may be H, C<sub>1</sub>-C<sub>12</sub> alkyl including linear, branched, cyclic alkyl, or aryl;

R<sub>14</sub> may be H, C<sub>1</sub>-C<sub>12</sub> alkyl including linear, branched, cyclic alkyl, or aryl;

R<sub>15</sub> may be C<sub>1</sub>-C<sub>12</sub> alkyl including linear, branched, or cyclic alkyl; and,

5 R<sub>16</sub> may be C<sub>1</sub>-C<sub>12</sub> alkyl including linear, branched, or cyclic alkyl.

4. The projectile of any of claims 1, 2 and 3 wherein the chemiluminescent agent is tetrakis(pyrrolidiny)ethylene.

5. The projectile of claim 1 wherein the solvent is selected from mineral oil, polyethylene glycol, silicone oil, vegetable oil and mixtures of the  
10 foregoing.

6. The projectile of claim 1 further comprising an activator.

7. The projectile of claim 6 wherein the activator is selected from organic alcohols and water.

8. The projectile of claim 6 wherein the activator is selected from iso-  
15 butanol, tert-butanol, ethylene glycol, ethylhexanol, n-octanol, iso-octanol, n-decanol, n-hexadecanol and mixtures of the foregoing.

9. The projectile of claim 1 further comprising a pigment.

10. The projectile of claim 9 wherein the pigment is selected from alumina, barium oxide, iron oxide, silica, titanium dioxide, zinc oxide and  
20 mixtures of the foregoing.

11. The projectile of claim 9 wherein the pigment is selected from FD&C yellow, blue and red, phthalocyanine green, phthalocyanine blue, and mixtures of the foregoing.

12. The projectile of claim 1 further comprising a surfactant.

25 13. The projectile of claim 1 further comprising a thickening agent.

14. The projectile of claim 13 wherein the thickening agent is selected from microcrystalline wax, candelilla wax, paraffin wax, virgin paraffin wax, petrolatum, polysorbitol and mixtures of the foregoing.

15. The projectile of claim 1 further comprising a fragrance.

30 16. The projectile of claim 15 wherein the perfume is selected from peppermint, spearmint, terpenoids,  $\beta$ -pinene, limonene, and mixtures of the foregoing.

17. The projectile of any of claims 1, 2, and 3 wherein the chemiluminescent agent is capable of a luminescent quantum yield in the range of 1 to 0.00001 Einsteins per mole.
18. The projectile of any of claims 1, 2, 3, and 17 wherein the  
5 chemiluminescent agent is capable of a luminescent quantum yield in the range of 1 to 0.001 Einsteins per mole.
19. A method for manufacturing a luminescent projectile comprising the steps of:
- preparing a fill material, the fill material comprising a  
10 chemiluminescent substrate and a solvent;
  - preparing a frangible shell;
  - filling the frangible shell with the fill material.
20. A method of marking an object comprising the steps of  
15 impacting a target with a frangible projectile that breaks upon impact releasing a chemiluminescent substrate to expose the chemiluminescent substrate to an oxidation source,
21. The method of claim 20 wherein the oxidation source is atmospheric oxygen.
22. A method as in Claim 20 wherein the oxidation source is contained in  
20 the projectile in a first compartment reactively separate from the chemiluminescent substrate, wherein the first compartment becomes reactively connected to the chemiluminescent substrate upon impact.
23. A method as in Claim 20, wherein the oxidation source is selected from the group consisting of hydrogen peroxide, alkyl peroxide and aryl  
25 peroxide.
24. A method of playing a paintball game comprising the steps of  
dividing two or more people into a first team and second team of  
players wherein each player has a marker for discharging paintballs, the  
paintballs comprising a chemiluminescent agent, a solvent; and a shell  
30 surrounding the chemiluminescent agent and the solvent;
- providing a playing surface with a first point and a second point;
  - positioning the first team near the first point, the first team having the objective to score points by marking players of the second team;

positioning the second team near the second point, the second team having the objective to score points by marking players of the first team;

awarding a point value to the first team each time a player from the first team marks a player from the second team and awarding a point value  
5 to the second team each time a player from the second team marks a player from the first team; and,

determining a winning team based on which of the first team and the second team accumulates the largest point total over a predetermined game time.

10 25. The method of claim 24 wherein the playing surface further includes a plurality of end lines, the playing surface being divided into a plurality of zones, the first team further having another objective to score points by carrying a first team flag to a first goal positioned near the first point without being marked by a player from the second team, the second team  
15 further having another objective to score points by carrying a second team flag through to a second goal positioned near the second point without being marked by a player from the first team, further comprising the steps of:

awarding a point value to the first team each time a player from the first team reaches the first goal carrying the first team flag, the point value  
20 being based upon the zone in which the first team flag is located when the first team reaches the first goal, and wherein the point value awarded to the first team increases the further the first team flag is from the first goal; and,

awarding a point value to the second team each time a player from the second team reaches the second goal carrying the second team flag, the point  
25 value being based upon the zone in which the second team flag is located when the second team reaches the second goal, and wherein the point value awarded to the second team increases the further the second team flag is from the second goal.

26. The method of claim 24 further comprising the step of removing one  
30 or more players from the playing surface when the player is marked by one or more of the paintballs.

27. The method of any of claims 24, 25, and 26 wherein the playing surface is outdoor.

28. The method of any of claims 24, 25, and 26 where the playing surface is located within a building.
29. A method of playing paint ball comprising using a single chamber shell with an autooxidative chemiluminescent agent.
- 5 30. A composition for chemiluminescence comprising:  
a chemiluminescent agent of from about 5% to about 10%;  
a wax of from about 2% to about 5%;  
a pigment of from about 0% to about 10%;  
a fragrance additive of from about 0% to about 3%;  
10 an organic alcohol of from about 0% to about 3%;  
a hydrophobic solvent of from about 70% to about 90%; and,  
a surfactant of from about 0% to about 3%.
31. A projectile consisting of single frangible chamber, wherein the chamber contains ingredients comprising an autooxidative chemiluminescent  
15 agent and a solvent.
32. The projectile of claim 31 wherein said autooxidative chemiluminescent agent reacts with atmospheric oxygen upon impact with a target.